

WHAT IS CLAIMED IS:

1           1.    A method of measuring comprising:  
2           providing an optical metrology target, the optical  
3 metrology target comprising:  
4           a first periodic structure comprising at least two  
5 features, the first periodic structure having a first pitch;  
6 and  
7           a second periodic structure comprising at least two  
8 features, the second periodic structure having a second pitch  
9 that differs from the first pitch;  
10          illuminating the optical metrology target with a light  
11 source;  
12          receiving an optical signal from the optical metrology  
13 target; and  
14          analyzing the optical signal.

1           2.    The method of claim 1 in which analyzing the optical  
2 signal comprises determining the first pitch.

1           3.    The method of claim 2 in which analyzing the optical  
2 signal further comprises determining the second pitch.

1           4.    The method of claim 3 in which analyzing the optical  
2    signal comprises determining the first pitch and the second  
3    pitch simultaneously.

1           5.    The method of claim 1 in which the measurement is  
2    non-destructive.

1           6.    The method of claim 1 in which the light source  
2    comprises a coherent light source.

1           7.    The method of claim 1 in which the light source  
2    comprises a non-coherent light source.

1           8.    The method of claim 1 in which the light source  
2    comprises a light source in the visible spectrum.

1           9.    The method of claim 1 in which the light source  
2    comprises a light source in the ultraviolet spectrum.

1           10.   The method of claim 1 in which analyzing the optical  
2    signal comprises using a computer program.

1           11.   The method of claim 1, in which the optical  
2    metrology target comprises a standalone test pad.

1           12. The method of claim 1, in which the optical  
2 metrology target mimics an electrical element.

1           13. The method of claim 12, in which the optical  
2 metrology target mimics a circuit structure.

1           14. The method of claim 13, in which the optical  
2 metrology target mimics a conductive structure.

1           15. The method of claim 13, in which the optical  
2 metrology target mimics an insulated structure.

1           16. The method of claim 15, in which the optical  
2 metrology target mimics a flash memory array.

1           17. The method of claim 1, in which the optical  
2 metrology target comprises two or more electrical elements.

1           18. The method of claim 1, in which the optical  
2 metrology target comprises a circuit structure.

1           19. The method of claim 18, in which the optical  
2 metrology target comprises a conductive structure.

1           20. The method of claim 17, in which the electrical  
2 element comprises a memory device element.

1           21. The method of claim 17, in which the electrical  
2 element comprises a logic device element.

1           22. The method of claim 1 in which each first feature  
2 comprises a width less than 100 nanometers.

1           23. The method of claim 1 in which the first pitch is  
2 less than 100 nanometers.

1           24. The method of claim 1 in which the first periodic  
2 structure is located adjacent to the second periodic  
3 structure.

1           25. The method of claim 1 in which the first periodic  
2 structure is located so as to overlap the second periodic  
3 structure.

1           26. The method of claim 1 in which an axis of the first  
2 periodic structure is parallel to an axis of the second  
3 periodic structure.

1           27. The method of claim 1 in which an axis of the first  
2 periodic structure is aligned with an axis of the second  
3 periodic structure.

1           28. The method of claim 1 in which at least one feature  
2 of the first periodic structure is a feature of the second  
3 periodic structure.

1           29. The method of claim 1 in which at least one feature  
2 of the first periodic structure is aligned with a feature of  
3 the second periodic structure.

1           30. The method of claim 1 in which at least one feature  
2 of the first periodic structure is connected to a feature of  
3 the second periodic structure.

1           31. The method of claim 1 in which the features of the  
2 first periodic structure comprise nested features.

1           32. The method of claim 31 in which a line-to-space  
2 ratio of the features of the first periodic structure  
3 comprises a value less than 1:3.

1           33. The method of claim 1 in which the features of the  
2 second periodic comprise isolated features.

1           34. The method of claim 33 in which a line--to-space  
2 ratio of the features of the second periodic structure  
3 comprises a value greater than or equal to 1:3.

1           35. The method of claim 1 in which the optical metrology  
2 target further comprises:

3                 a third periodic structure comprising at least two  
4 features, the third periodic structure having a third pitch;  
5 and

6                 a fourth periodic structure comprising at least two  
7 features, the fourth periodic structure having a fourth pitch  
8 that differs from the third pitch.

1           36. The method of claim 35 in which:  
2                 the first periodic structure and the second periodic  
3 structure are aligned with respect to a first axis of the  
4 optical metrology target; and

5                 the third periodic structure and the fourth periodic  
6 structure are aligned with respect to a second axis of the  
7 optical metrology target.

1           37. The method of claim 36 in which analyzing the  
2 optical signal comprises determining the third pitch.

1           38. The method of claim 31 in which analyzing the  
2 optical signal comprises determining the fourth pitch.

1           39. The method of claim 1 in which a shape of at least  
2 two features of the first periodic structure comprises a  
3 rectilinear shape.

1           40. The method of claim 1 in which a shape of at least  
2 two features of the first periodic structure comprises a  
3 curvilinear shape.

1           41. The method of claim 1 in which the optical metrology  
2 target is provided in a first layer of a device.

1           42. The method of claim 41 further comprising:  
2 providing a second optical metrology target in a second  
3 layer of the device, the second optical metrology target  
4 comprising:

5           a third periodic structure comprising at least two  
6 features, the third periodic structure having a third pitch;  
7 and

8 a fourth periodic structure comprising at least two  
9 features, the fourth periodic structure having a fourth pitch  
10 that differs from the third pitch.

1 43. The method of claim 42 in which analyzing the  
2 optical signal comprises determining the offset between the  
3 optical metrology target in the first layer of the device and  
4 the second optical metrology target in the second layer of the  
5 device.

1 44. The method of claim 43 in which:  
2 the third pitch of the second optical metrology target in  
3 the second layer of the device is equal to the first pitch of  
4 the optical metrology target in the first layer of the device;  
5 and

6 the fourth pitch of the second optical metrology  
7 target in the second layer of the device is equal to the  
8 second pitch of the optical metrology target in the first  
9 layer of the device.

1 45. An optical metrology target comprising:  
2 a first periodic structure comprising at least two  
3 features, the first periodic structure having a first pitch;  
4 and



5 a second periodic structure comprising at least two  
6 features, the second periodic structure having a second pitch  
7 that differs from the first pitch.

1 46. The optical metrology target of claim 45 in which:  
2 each first feature further comprises a length and a  
3 width; and  
4 each second feature further comprises a length and a  
5 width.

1 47. The optical metrology target of claim 46 in which  
2 the length of each first feature is equal to the length of  
3 each second feature.

1 48. The optical metrology target of claim 47 in which  
2 the width of each first feature is equal to the width of each  
3 second feature.

1 49. The optical metrology target of claim 46 in which  
2 the width of each first feature is less than 100 nanometers.

1 50. The optical metrology target of claim 45 in which  
2 the first pitch is less than 100 nanometers.

1           51. The optical metrology target of claim 45 in which  
2 the first periodic structure is located adjacent to the second  
3 periodic structure.

1           52. The optical metrology target of claim 45 in which  
2 the first periodic structure is located so as to overlap the  
3 second periodic structure.

1           53. The optical metrology target of claim 45 in which an  
2 axis of the first periodic structure is parallel to an axis of  
3 the second periodic structure.

1           54. The optical metrology target of claim 45 in which an  
2 axis of the first periodic structure is aligned with an axis  
3 of the second periodic structure.

1           55. The optical metrology target of claim 45 in which at  
2 least one feature of the first periodic structure is a feature  
3 of the second periodic structure.

1           56. The optical metrology target of claim 45 in which at  
2 least one feature of the first periodic structure is aligned  
3 with a feature of the second periodic structure.

1           57. The optical metrology target of claim 45 in which at  
2           least one feature of the first periodic structure is connected  
3           to a feature of the second periodic structure.

1           58. The optical metrology target of claim 45 in which  
2           the features of the first periodic structure comprise nested  
3           features.

1           59. The optical metrology target of claim 58 in which a  
2           line-to-space ratio of the features of the first periodic  
3           structure comprises a value less than 1:3.

1           60. The optical metrology target of claim 45 in which  
2           the features of the second periodic comprise isolated  
3           features.

1           61. The optical metrology target of claim 60 in which a  
2           line-to-space ratio of the features of the second periodic  
3           structure comprises a value greater than or equal to 1:3.

1           62. An integrated circuit comprising:  
2           at least one electrical element; and  
3           an optical metrology target, the optical metrology target  
4           comprising:

5 a first periodic structure comprising at least two  
6 features, the first periodic structure having a first pitch;  
7 and

8 a second periodic structure comprising at least two  
9 features, the second periodic structure having a second pitch  
10 that differs from the first pitch.

1 63. The integrated circuit of claim 62, in which the  
2 optical metrology target comprises a standalone test pad.

1 64. The integrated circuit of claim 62, in which the  
2 optical metrology target mimics the electrical element.

1 65. The integrated circuit of claim 64, in which the  
2 optical metrology target mimics a flash memory array.

1 66. The integrated circuit of claim 64, in which the  
2 optical metrology target comprises a circuit structure.

1 67. The integrated circuit of claim 62, in which the  
2 optical metrology target comprises two or more electrical  
3 elements.

1           68. The integrated circuit of claim 62 in which the  
2 first periodic structure is located adjacent to the second  
3 periodic structure.

1           69. The integrated circuit of claim 62 in which the  
2 first periodic structure is located so as to overlap the  
3 second periodic structure.

1           70. The integrated circuit of claim 62 in which at least  
2 one feature of the first periodic structure is a feature of  
3 the second periodic structure.

1           71. The integrated circuit of claim 62 in which at least  
2 one feature of the first periodic structure is aligned with a  
3 feature of the second periodic structure.

1           72. The integrated circuit of claim 62 in which at least  
2 one feature of the first periodic structure is connected to a  
3 feature of the second periodic structure.

1           73. The integrated circuit of claim 62 in which the  
2 optical metrology target further comprises:

3 a third periodic structure comprising at least two  
4 features, the third periodic structure having a third pitch;  
5 and

6 a fourth periodic structure comprising at least two  
7 features, the fourth periodic structure having a fourth pitch  
8 that differs from the third pitch.

1 74. The integrated circuit of claim 73 in which:

2 the first periodic structure and the second periodic  
3 structure are aligned with respect to a first axis of the  
4 optical metrology target; and

5 the third periodic structure and the fourth periodic  
6 structure are aligned with respect to a second axis of the  
7 optical metrology target.

1 75. The integrated circuit of claim 74 in which the  
2 first axis of the optical metrology target is perpendicular to  
3 the second axis of the optical metrology target.

1 76. The integrated circuit of claim 74 in which  
2 analyzing the optical signal comprises determining the third  
3 pitch.

1           77. The integrated circuit of claim 74 in which  
2 analyzing the optical signal comprises determining the fourth  
3 pitch.

1           78. The integrated circuit of claim 62 in which a shape  
2 of at least two features of the first periodic structure  
3 comprises a rectilinear shape.

1           79. The integrated circuit of claim 62 in which a shape  
2 of at least two features of the first periodic structure  
3 comprises a curvilinear shape.

1           80. The integrated circuit of claim 62 in which the  
2 optical metrology target is provided in a first layer of a  
3 device.

1           81. The integrated circuit of claim 80 further  
2 comprising:  
3           providing a second optical metrology target in a second  
4 layer of the device, the second optical metrology target  
5 comprising:  
6           a third periodic structure comprising at least two  
7 features, the third periodic structure having a third pitch;  
8 and

9 a fourth periodic structure comprising at least two  
10 features, the fourth periodic structure having a fourth pitch  
11 that differs from the third pitch.

1 82. The integrated circuit of claim 81 in which  
2 analyzing the optical signal comprises determining the offset  
3 between the optical metrology target in the first layer of the  
4 device and the second optical metrology target in the second  
5 layer of the device.

1 83. The integrated circuit of claim 82 in which:  
2 the third pitch of the second optical metrology target in  
3 the second layer of the device is equal to the first pitch of  
4 the optical metrology target in the first layer of the device;  
5 and

6 the fourth pitch of the second optical metrology  
7 target in the second layer of the device is equal to the  
8 second pitch of the optical metrology target in the first  
9 layer of the device.

1 84. An integrated circuit comprising:  
2 at least one electrical element; and  
3 an optical metrology target, the optical metrology target  
4 comprising:



5 a first means for measuring a first periodic structure;  
6 and  
7 a second means for measuring a second periodic structure.

1 85. The integrated circuit of claim 84, in which the  
2 optical metrology target comprises a standalone test pad.

1 86. The integrated circuit of claim 84, in which the  
2 optical metrology target mimics the electrical element.

1 87. The integrated circuit of claim 84, in which the  
2 optical metrology target mimics a circuit structure.

1 88. The integrated circuit of claim 86, in which the  
2 optical metrology target mimics a memory device element.

1 89. The integrated circuit of claim 84, in which the  
2 optical metrology target comprises two or more electrical  
3 elements.

1 90. The integrated circuit of claim 84 in which:  
2 the first means for measuring a first periodic structure  
3 comprises a means for measuring a first pitch of the first  
4 periodic structure; and

5           the second means for measuring a second periodic  
6   structure comprises a means for measuring a second pitch of  
7   the second periodic structure;  
8           in which the second pitch differs from the first pitch.